

MPLS Observation Lab – LDP Neighbors

Objective

The purpose of this lab is to observe the establishment of an **LDP peering** between two routers. This is an observation-focused lab. The learner should focus on observing how MPLS and LDP-related tables change as the LDP peering is established.

Topology Overview

RTR1 and RTR2 are currently not configured for MPLS.

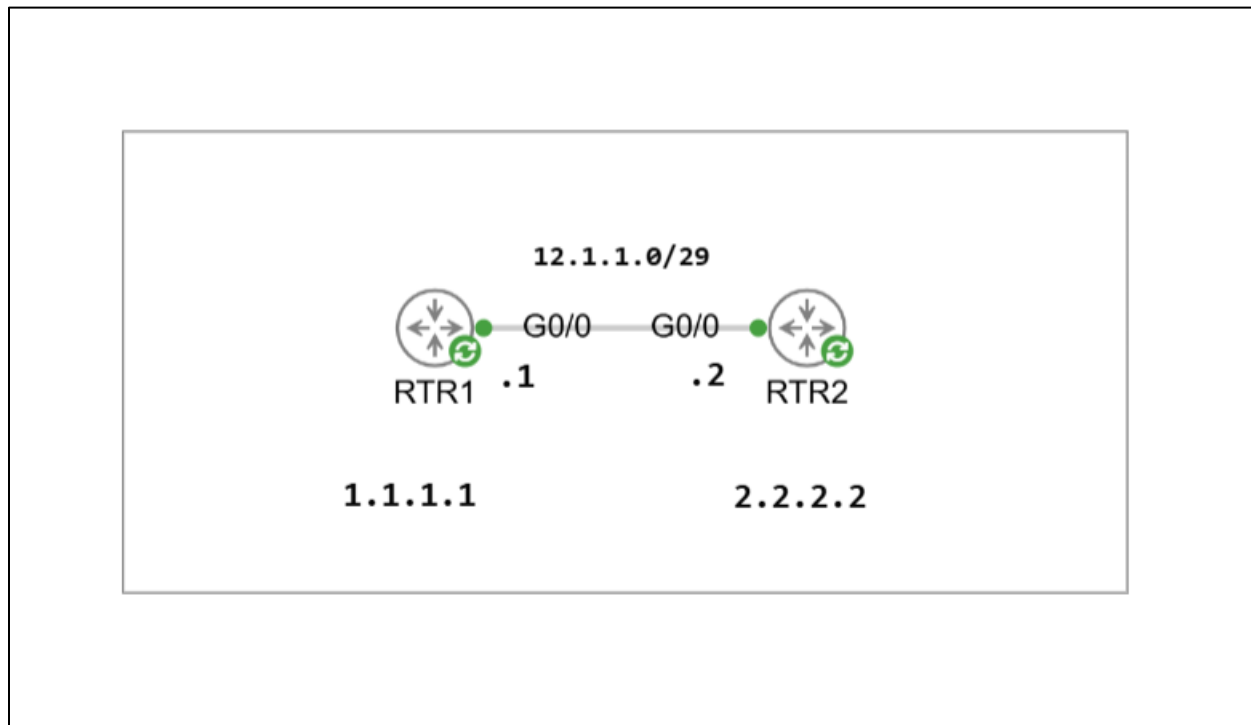


Figure 1 – Topology

Task 1 – Explore LDP Neighbor Peering Operations

- a. On RTR1, view the MPLS interfaces.

```
RTR1# show mpls interface
```

Observe

The table is empty, which is to be expected. MPLS has not been enabled on the interfaces.

- b. On RTR1 and RTR2, enable MPLS on interface Gi0/0. Then view the MPLS interfaces and neighbor table.

```
RTR(config)# interface GigabitEthernet0/0
RTR(config-if)# mpls ip
RTR# show mpls ldp neighbor
```

Observe

On both routers, interface Gi0/0 appears in the MPLS interface table; however, no LDP neighbor has been established.

```
RTR1#sh mpls interfaces
Interface      IP      Tunnel  BGP  Static  Operational
GigabitEthernet0/0  Yes (ldp)  No      No   No      Yes
RTR1#
```

Figure 2 – RTR1 show mpls interfaces output

Engineer Insight

Enabling MPLS on an interface also enables the **Label Distribution Protocol (LDP)**. LDP is used to exchange label binding information after an LDP peering has been established. Neighbors are discovered by sending **LDP Hello messages** on **UDP port 646** to the All Routers multicast address **224.0.0.2**. The packet capture in *Figure 3* shows this exchange between RTR1 and RTR2. Note the source IP of the Hello messages.

154	119.482134416	58:01:00:01:00:00	58:01:00:01:00:00	LOOP	60 Reply
155	121.982515144	12.1.1.2	224.0.0.2	LDP	76 Hello Message
156	122.588600862	12.1.1.1	224.0.0.2	LDP	76 Hello Message

Figure 3 – MPLS Hello Message Packet Capture output

- c. On RTR1 and RTR2, issue the following command.

```
RTR1# show mpls ldp discovery detail
```

Observe

The command displays local and remote information related to the neighbor discovery process. Each router “sees” the other, but no peering has been established. Observe the **Local LDP Identifier (router-id)**, **Src IP addr**, and **Transport IP addr** fields along with the line “**no route to transport addr**”.

```
RTR1#show mpls ldp discovery detail
Local LDP Identifier:
  1.1.1.1:0
Discovery Sources:
Interfaces:
  GigabitEthernet0/0 (ldp): xmit/recvd
    Enabled: Interface config
    Hello interval: 5000 ms; Transport IP addr: 1.1.1.1
    LDP Id: 2.2.2.2:0; no route to transport addr
    Src IP addr: 12.1.1.2; Transport IP addr: 2.2.2.2
    Hold time: 15 sec; Proposed local/peer: 15/15 sec
    Password: not required, none, in use
    Clients: IPv4
RTR1#
```

Figure 4 – RTR1 show mpls ldp discovery detail output

Question

- RTR1 and RTR2 are directly connected to network 12.1.1.0/29 and exchanging Hellos using their respective IP. Why would the systems show no route to the neighbor?

Engineer Insight

When MPLS is enabled, an LDP router-id is selected. The order of selection is a manually configured ID, the highest IP on a loopback, followed by the highest IP on another active interface.

By default, the router-id is also used as the LDP transport IP, but they serve different purposes. The router-id identifies the device, while the transport IP is used to establish a **TCP** connection on **port 646**. The packet capture in *Figure 5* shows the router-id and transport IP being shared as part of the Hello message. This explains how the routers are aware of each other but not forming a peering.

Recall that the LDP Hellos used to discover the neighbor were sourced from the directly connected 12.1.1.0/29 network. The IP address used for LDP neighbor discovery is not automatically the IP address used to establish the TCP connection.

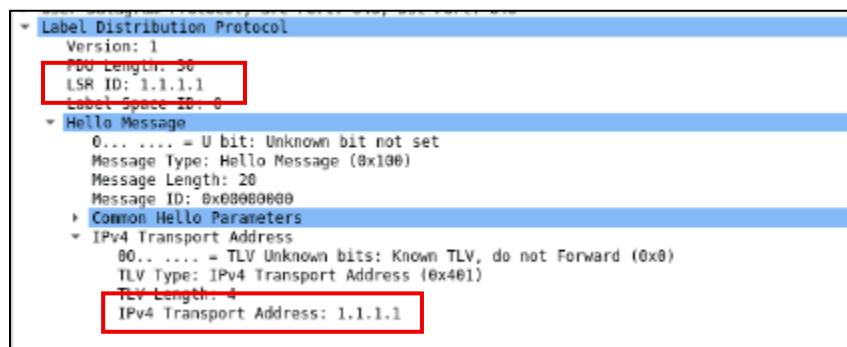


Figure 5 – RTR1 show mpls ldp discovery detail output

RTR1 and RTR2 have both selected the highest loopback as their router-id resulting in the transport IP being that of the loopback. If you check the routing tables, you'll see that neither RTR1 nor RTR2 has a route to the other's loopback, preventing the required TCP connection from being established. The transport IP must be reachable for RTR1 and RTR2 to form an LDP peering.

Although this issue could easily be resolved by adding static routes or advertising the loopbacks into an IGP, this lab intentionally demonstrates an alternative approach so the learner can better observe the relationship between the router-id and the LDP transport IP.

Task 2 – Manipulate LDP Transport IP

- a. On RTR1, issue the following command, then view the LDP discovery information on RTR1 and RTR2.

```
RTR1(config)# mpls ldp router-id gi0/0 force
```

Observe

RTR1's router-id has changed from 1.1.1.1 to Gi0/0's 12.1.1.1. Because the router-id is also used as the transport IP, the transport IP has changed to 12.1.1.1 as well. RTR2 no longer shows "no route to transport addr" but now shows **"no host route to transport addr"**. What this is saying is that there is no host, or /32, route to RTR1's transport IP, but one is not required to establish a peering. Lastly, RTR2's output shows that RTR1 is **"Reachable via 12.1.1.0/29"**.

```
RTR1#show mpls ldp discovery detail
Local LDP Identifier:
 12.1.1.1:0
Discovery Sources:
Interfaces:
  GigabitEthernet0/0 (ldp): xmit/recv
    Enabled: Interface config
    Hello interval: 5000 ms; Transport IP addr: 12.1.1.1
    LDP Id: 2.2.2.2:0; no route to transport addr
    Src IP addr: 12.1.1.2; Transport IP addr: 2.2.2.2
    Hold time: 15 sec; Proposed local/peer: 15/15 sec
    Password: not required, none, in use
    Clients: IPv4
RTR1#
```

Figure 6 – RTR1 show mpls ldp discovery detail output

```
RTR2#show mpls ldp discovery detail
Local LDP Identifier:
 2.2.2.2:0
Discovery Sources:
Interfaces:
  GigabitEthernet0/0 (ldp): xmit/recv
    Enabled: Interface config
    Hello interval: 5000 ms; Transport IP addr: 2.2.2.2
    LDP Id: 12.1.1.1:0; no host route to transport addr
    Src IP addr: 12.1.1.1; Transport IP addr: 12.1.1.1
    Hold time: 15 sec; Proposed local/peer: 15/15 sec
    Reachable via 12.1.1.0/29
    Password: not required, none, in use
    Clients: IPv4
RTR2#
```

Figure 7 – RTR2 show mpls ldp discovery detail output

Engineer Insight

The `mpls ldp router-id` command is used to manually set the LDP router-id. If this command is entered after the router-id has already been selected, the **force** keyword is required for the change to take effect immediately.

- b. On RTR2, issue the following command then view the MPLS LDP discovery information.

```
RTR2(config)# interface Gi0/0
RTR2(config-if)# mpls ldp discovery transport-address interface
```

Observe

RTR2's router-id remains 2.2.2.2 while the transport IP is now 12.1.1.2. The LDP peering between RTR1 and RTR2 has been established.

```
RTR2#show mpls ldp discovery detail
Local LDP Identifier:
  2.2.2.2:0
Discovery Sources:
Interfaces:
  GigabitEthernet0/0 (ldp): xmit/rcv
    Enabled: Interface config
    Hello interval: 5000 ms; Transport IP addr: 12.1.1.2
    LDP Id: 12.1.1.1:0; no host route to transport addr
    Src IP addr: 12.1.1.1; Transport IP addr: 12.1.1.1
    Hold time: 15 sec; Proposed local/peer: 15/15 sec
    Reachable via 12.1.1.0/29
    Password: not required, none, in use
    Clients: IPv4
RTR2#
```

Figure 8 – RTR2 show mpls ldp discovery detail output

```
RTR2#show mpls ldp neighbor
Peer LDP Ident: 12.1.1.1:0; Local LDP Ident 2.2.2.2:0
TCP connection: 12.1.1.1.646 - 12.1.1.2.48764
State: Oper; Msgs sent/rcvd: 12/11; Downstream
Up time: 00:06:02
LDP discovery sources:
  GigabitEthernet0/0, Src IP addr: 12.1.1.1
Addresses bound to peer LDP Ident:
  12.1.1.1      1.1.1.1
RTR2#
```

Figure 9 – RTR2 show mpls ldp discovery detail output

Engineer Insight

The `mpls ldp discovery transport-address interface` command is used to modify the LDP transport IP while leaving the router-id unchanged. With RTR1 and RTR2 now using the IPs of the shared, connected network for transport an LDP peering is established. The line **“TCP connection: 12.1.1.1.646 – 12.1.1.2.48764”** confirms this.

Lab Summary

You observed that:

- LDP Hellos are sent on UDP port 646 to the “All Routers” multicast address (224.0.0.2).
- To establish an LDP peering, the transport IP addresses must be reachable.
- LDP establishes TCP sessions using port 646.
- By default, the LDP router-id becomes the transport IP address.
- LDP is enabled automatically when MPLS is configured on an interface.